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## LIQUID DISH CLEANING COMPOSITIONS

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## LIQUID DISH CLEANING COMPOSITIONS

### Field of Invention

This invention relates to a liquid dish cleaning composition which is designed to have improved foaming properties and excellent grease cutting properties.

### Background of the Invention

The present invention relates to novel light duty liquid detergent compositions with high foaming and good grease cutting properties.

The prior art is replete with light duty liquid detergent compositions containing nonionic surfactants in combination with anionic and/or betaine surfactants wherein the nonionic detergent is not the major active surfactant. In U.S. Patent No. 3,658,985 an anionic based shampoo contains a minor amount of a fatty acid alkanolamide. U.S. Patent No. 3,769,398 discloses a betaine-based shampoo containing minor amounts of nonionic surfactants. This patent states that the low foaming properties of nonionic detergents renders its use in shampoo compositions non-preferred. U.S. Patent No. 4,329,335 also discloses a shampoo containing a betaine surfactant as the major ingredient and minor amounts of a nonionic surfactant and of a fatty acid mono- or di-ethanolamide. U.S. Patent No. 4,259,204 discloses a shampoo comprising 0.8 to 20% by weight of an anionic phosphoric acid ester and one additional surfactant which may be either anionic, amphoteric, or nonionic. U.S. Patent No. 4,329,334 discloses an anionic-amphoteric based shampoo containing a major amount of anionic surfactant and lesser amounts of a betaine and nonionic surfactants.

U.S. Patent No. 3,935,129 discloses a liquid cleaning composition containing an alkali metal silicate, urea, glycerin, triethanolamine, an anionic detergent and a nonionic detergent. The silicate content determines the amount of anionic and/or nonionic detergent in the liquid cleaning composition. However, the foaming properties of these detergent compositions are not discussed therein.

U.S. Patent No. 4,129,515 discloses a heavy duty liquid detergent for laundering fabrics comprising a mixture of substantially equal amounts of anionic and nonionic

surfactants, alkanolamines and magnesium salts, and, optionally, zwitterionic surfactants as suds modifiers.

U.S. Patent No. 4,224,195 discloses an aqueous detergent composition for laundering socks or stockings comprising a specific group of nonionic detergents, namely, an ethylene oxide of a secondary alcohol, a specific group of anionic detergents, namely, a sulfuric ester salt of an ethylene oxide adduct of a secondary alcohol, and an amphoteric surfactant which may be a betaine, wherein either the anionic or nonionic surfactant may be the major ingredient.

The prior art also discloses detergent compositions containing all nonionic surfactants as shown in U.S. Patent Nos. 4,154,706 and 4,329,336 wherein the shampoo compositions contain a plurality of particular nonionic surfactants in order to affect desirable foaming and deterative properties despite the fact that nonionic surfactants are usually deficient in such properties.

U.S. Patent No. 4,013,787 discloses a piperazine based polymer in conditioning and shampoo compositions which may contain all nonionic surfactant or all anionic surfactant.

U.S. Patent No. 4,450,091 discloses high viscosity shampoo compositions containing a blend of an amphoteric betaine surfactant, a polyoxybutylenepolyoxyethylene nonionic detergent, an anionic surfactant, a fatty acid alkanolamide and a polyoxyalkylene glycol fatty ester. But, none of the exemplified compositions contain an active ingredient mixture wherein the nonionic detergent is present in major proportion which is probably due to the low foaming properties of the polyoxybutylene polyoxyethylene nonionic detergent.

U.S. Patent No. 4,595,526 describes a composition comprising a nonionic surfactant, a betaine surfactant, an anionic surfactant and a C<sub>12</sub>-C<sub>14</sub> fatty acid monoethanolamide foam stabilizer.

U.S. Patent 6,147,039 teaches an antibacterial hand cleaning composition having a low surfactant content.

### Summary of the Invention

It has now been found that a liquid dish cleaning composition can be formulated with three different anionic surfactants, an amine oxide surfactant, an alkyl polyglucoside surfactant, an organic amine and water which has improved grease cutting and foaming properties.

An object of this invention is to provide a liquid dish cleaning composition which comprises a sulfate surfactant, two sulfonate anionic surfactants, an alkyl polyglucoside surfactant, an amine oxide surfactant, an organic amine and water, wherein the composition does not contain any silicas, abrasives, acyl isoethionate, 2-hydroxy-4,2',4'-trichloridiphenyl ether, phosphoric acid, phosphonic acid, boric acid, organic acids, alkali metal carbonates, alkaline earth metal carbonates, alkyl glycine surfactant, cyclic imidinium surfactant, or more than 3 wt. % of a fatty acid or salt thereof.

Another object of this invention is to provide a liquid dish cleaning composition with desirable high foaming and grease cutting properties.

Additional objects, advantages and novel features of the invention will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

### Detailed Description of the Invention

This invention relates to a liquid dish cleaning composition which comprises approximately by weight:

- (a) 0.1% to 6% of a sodium salt of a C<sub>8</sub>-C<sub>16</sub> linear alkyl benzene sulfonate surfactant;
- (b) 5% to 15% of a magnesium salt of a C<sub>8</sub>-C<sub>16</sub> linear alkyl benzene sulfonate surfactant;
- (c) 6% to 15% of an ammonium or sodium salt of an ethoxylated C<sub>8</sub>-C<sub>18</sub> alkyl ether sulfate surfactant;

- (d) 2% to 15% of an amine oxide surfactant;
- (e) 0.5% to 3%, more preferably 0.75% to 3% of a C<sub>8</sub>-C<sub>14</sub> amido C<sub>1</sub>-C<sub>3</sub> alkyl amine such as C<sub>8</sub>/C<sub>10</sub> amido propyl amine;
- (f) 5% to 15% of an alkyl polyglucoside surfactant;
- 5 (g) 0.1% to 12% of solubilizing system; and
- (h) the balance being water, wherein the composition has a pH of 6.5 to 7.5 and has a viscosity of 100 to 1,000 cps, more preferably 200 to 600 cps at 25°C using a #21 spindle at 20 rpm as measured on a Brookfield RVTDV-II viscometer, wherein the composition does not contain any grease release agents such as choline, chloride
- 10 or buffering system which is a nitrogerious buffer which is ammonium or alkaline earth carbonate, guanidine derivates, C<sub>3</sub>-C<sub>7</sub> alkyl and alkenyl monobasic and dibasic acids such as C<sub>4</sub>-C<sub>7</sub> aliphatic carboxylic diacids boric acid, phosphoric acid, and amino alkylene phosphonic acid and the composition is pourable and is not a gel.

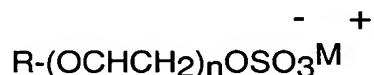
The anionic sulfonate surfactants which may be used in the detergent of this  
 15 invention are selected from the consisting of water soluble and include the sodium, potassium, ammonium, magnesium and ethanolammonium salts of linear C<sub>8</sub>-C<sub>16</sub> alkyl benzene sulfonates; C<sub>10</sub>-C<sub>20</sub> paraffin sulfonates, alpha olefin sulfonates containing about 10-24 carbon atoms and C<sub>8</sub>-C<sub>18</sub> alkyl sulfates and mixtures thereof.

The paraffin sulfonates may be monosulfonates or di-sulfonates and usually are  
 20 mixtures thereof, obtained by sulfonating paraffins of 10 to 20 carbon atoms. Preferred paraffin sulfonates are those of C<sub>12</sub>-18 carbon atoms chains, and more preferably they are of C<sub>14</sub>-17 chains. Paraffin sulfonates that have the sulfonate group(s) distributed along the paraffin chain are described in U.S. Patents 2,503,280; 2,507,088; 3,260,744; and 3,372,188; and also in German Patent 735,096. Such compounds may  
 25 be made to specifications and desirably the content of paraffin sulfonates outside the C<sub>14</sub>-17 range will be minor and will be minimized, as will be any contents of di- or poly-sulfonates.

Examples of suitable other sulfonated anionic detergents are the well known higher alkyl mononuclear aromatic sulfonates, such as the higher alkylbenzene

sulfonates containing 9 to 18 or preferably 9 to 16 carbon atoms in the higher alkyl group in a straight or branched chain, or C<sub>8</sub>-15 alkyl toluene sulfonates. A preferred alkylbenzene sulfonate is a linear alkylbenzene sulfonate having a higher content of 3-phenyl (or higher) isomers and a correspondingly lower content (well below 50%) of 2-phenyl (or lower) isomers, such as those sulfonates wherein the benzene ring is attached mostly at the 3 or higher (for example 4, 5, 6 or 7) position of the alkyl group and the content of the isomers in which the benzene ring is attached in the 2 or 1 position is correspondingly low. Preferred materials are set forth in U.S. Patent 3,320,174, especially those in which the alkyls are of 10 to 13 carbon atoms.

The C<sub>8</sub>-18 ethoxylated alkyl ether sulfate surfactants have the structure

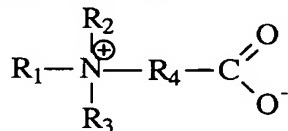


wherein n is about 1 to about 22 more preferably 1 to 3 and R is an alkyl group having about 8 to about 18 carbon atoms, more preferably 12 to 15 and natural cuts, for example, C<sub>12</sub>-14 or C<sub>12</sub>-16 and M is an ammonium cation or a metal cation, most preferably sodium.

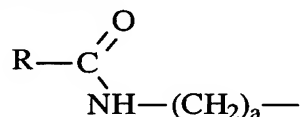
The ethoxylated alkyl ether sulfate may be made by sulfating the condensation product of ethylene oxide and C<sub>8</sub>-10 alkanol, and neutralizing the resultant product. The ethoxylated alkyl ether sulfates differ from one another in the number of carbon atoms in the alcohols and in the number of moles of ethylene oxide reacted with one mole of such alcohol. Preferred ethoxylated alkyl ether polyethenoxy sulfates contain 12 to 15 carbon atoms in the alcohols and in the alkyl groups thereof, e.g., sodium myristyl (3 EO) sulfate.

Ethoxylated C<sub>8</sub>-18 alkylphenyl ether sulfates containing from 2 to 6 moles of ethylene oxide in the molecule are also suitable for use in the invention compositions. These detergents can be prepared by reacting an alkyl phenol with 2 to 6 moles of ethylene oxide and sulfating and neutralizing the resultant ethoxylated alkylphenol. The concentration of the ethoxylated alkyl ether sulfate surfactant is about 1 to about 8 wt. %.

The water-soluble zwitterionic surfactant, which can also be used provides good foaming properties and mildness to the present nonionic based liquid detergent. The zwitterionic surfactant is a water soluble betaine having the general formula:

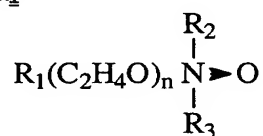


- 5 wherein R<sub>1</sub> is an alkyl group having 10 to 20 carbon atoms, preferably 12 to 16 carbon atoms, or the amido radical:

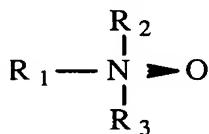


- wherein R is an alkyl group having 9 to 19 carbon atoms and a is the integer 1 to 4; R<sub>2</sub> and R<sub>3</sub> are each alkyl groups having 1 to 3 carbons and preferably 1 carbon; R<sub>4</sub> is an  
10 alkylene or hydroxyalkylene group having from 1 to 4 carbon atoms and, optionally, one hydroxyl group. Typical alkyldimethyl betaines include decyl dimethyl betaine or 2-(N-decyl-N, N-dimethyl-ammonia) acetate, coco dimethyl betaine or 2-(N-coco N, N-dimethylammonio) acetate, myristyl dimethyl betaine, palmityl dimethyl betaine, lauryl diemethyl betaine, cetyl dimethyl betaine, stearyl dimethyl betaine, etc. The  
15 amidobetaines similarly include cocoamidoethylbetaine, cocoamidopropyl betaine and the like. A preferred betaine is coco (C<sub>8</sub>-C<sub>18</sub>) amidopropyl dimethyl betaine.

Amine oxide semi-polar nonionic surfactants comprise compounds and mixtures of compounds having the formula:



- 20 wherein R<sub>1</sub> is an alkyl, 2-hydroxyalkyl, 3-hydroxyalkyl, or 3-alkoxy-2-hydroxypropyl radical in which the alkyl and alkoxy, respectively, contain from 8 to 18 carbon atoms, R<sub>2</sub> and R<sub>3</sub> are each methyl, ethyl, propyl, isopropyl, 2-hydroxyethyl, 2-hydroxypropyl, or 3-hydroxypropyl, and n is from 0 to 10. Particularly preferred are amine oxides of the formula:



wherein  $R_1$  is a  $C_{12-16}$  alkyl and  $R_2$  and  $R_3$  are methyl or ethyl. The above ethylene oxide condensates, amides, and amine oxides are more fully described in U.S. Pat. No. 4,316,824 which is hereby incorporated herein by reference.

5           The instant composition can contain a mixture of a  $C_{12-14}$  alkyl monoalkanol amide such as lauryl monoalkanol amide and a  $C_{12-14}$  alkyl dialkanol amide such as lauryl diethanol amide or coco diethanol amide.

          As used herein and in the appended claims the term "perfume" is used in its ordinary sense to refer to and include any non-water soluble fragrant substance or  
10       mixture of substances including natural (i.e., obtained by extraction of flower, herb, blossom or plant), artificial (i.e., mixture of natural oils or oil constituents) and synthetically produced substance) odoriferous substances. Typically, perfumes are complex mixtures of blends of various organic compounds such as alcohols, aldehydes, ethers, aromatic compounds and varying amounts of essential oils (e.g.,  
15       terpenes) such as from 0% to 80%, usually from 10% to 70% by weight, the essential oils themselves being volatile odoriferous compounds and also serving to dissolve the other components of the perfume.

          In the present invention the precise composition of the perfume is of no particular consequence to cleaning performance so long as it meets the criteria of  
20       water immiscibility and having a pleasing odor. Naturally, of course, especially for cleaning compositions intended for use in the home, the perfume, as well as all other ingredients, should be cosmetically acceptable, i.e., non-toxic, hypoallergenic, etc.. The instant compositions show a marked improvement in ecotoxicity as compared to existing commercial products.

25           The alkyl polysaccharides surfactants, which can be used at a hydrophobic group containing from about 8 to about 20 carbon atoms, preferably from about 10 to about 16 carbon atoms, most preferably from about 12 to about 14 carbon atoms, and polysaccharide hydrophilic group containing from about 1.5 to about 10, preferably from about 1.5 to about 4, most preferably from about 1.6 to about 2.7 saccharide units



(e.g., galactoside, glucoside, fructoside, glucosyl, fructosyl; and/or galactosyl units).

Mixtures of saccharide moieties may be used in the alkyl polysaccharide surfactants.

The number x indicates the number of saccharide units in a particular alkyl

polysaccharide surfactant. For a particular alkyl polysaccharide molecule x can only

5 assume integral values. In any physical sample of alkyl polysaccharide surfactants

there will be in general molecules having different x values. The physical sample can

be characterized by the average value of x and this average value can assume non-

integral values. In this specification the values of x are to be understood to be average

values. The hydrophobic group (R) can be attached at the 2-, 3-, or 4- positions rather

10 than at the 1-position, (thus giving e.g. a glucosyl or galactosyl as opposed to a

glucoside or galactoside). However, attachment through the 1- position, i.e.,

glucosides, galactoside, fructosides, etc., is preferred. In the preferred product the

additional saccharide units are predominately attached to the previous saccharide unit's

2-position. Attachment through the 3-, 4-, and 6- positions can also occur. Optionally

15 and less desirably there can be a polyalkoxide chain joining the hydrophobic moiety (R)

and the polysaccharide chain. The preferred alkoxide moiety is ethoxide.

Typical hydrophobic groups include alkyl groups, either saturated or

unsaturated, branched or unbranched containing from about 8 to about 20, preferably

from about 10 to about 18 carbon atoms. Preferably, the alkyl group is a straight chain

20 saturated alkyl group. The alkyl group can contain up to 3 hydroxy groups and/or the

polyalkoxide chain can contain up to about 30, preferably less than about 10, alkoxide

moieties.

Suitable alkyl polysaccharides are decyl, dodecyl, tetradecyl, pentadecyl,

hexadecyl, and octadecyl, di-, tri-, tetra-, penta-, and hexagluco- sides, galactosides,

25 lactosides, fructosides, fructosyls, lactosyls, glucosyls and/or galactosyls and mixtures

thereof.

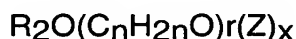
The alkyl monosaccharides are relatively less soluble in water than the higher

alkyl polysaccharides. When used in admixture with alkyl polysaccharides, the alkyl

monosaccharides are solubilized to some extent. The use of alkyl monosaccharides in

admixture with alkyl polysaccharides is a preferred mode of carrying out the invention. Suitable mixtures include coconut alkyl, di-, tri-, tetra-, and pentagluco-  
 5 alkyl tetra-, penta-, and hexagluco-

The preferred alkyl polysaccharides are alkyl polyglucosides having the formula



wherein Z is derived from glucose, R is a hydrophobic group selected from the group consisting of alkyl, alkylphenyl, hydroxyalkylphenyl, and mixtures thereof in which said alkyl groups contain from about 10 to about 18, preferably from about 12 to about 14 carbon atoms; n is 2 or 3 preferably 2, r is from 0 to 10, preferable 0; and x is from 1.5  
 10 to 8, preferably from 1.5 to 4, most preferably from 1.6 to 2.7. To prepare these compounds a long chain alcohol ( $R_2OH$ ) can be reacted with glucose, in the presence of an acid catalyst to form the desired glucoside. Alternatively the alkyl polyglucosides can be prepared by a two step procedure in which a short chain alcohol ( $R_1OH$ ) can be reacted with glucose, in the presence of an acid catalyst to form the desired glucoside.

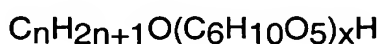
15 Alternatively the alkyl polyglucosides can be prepared by a two step procedure in which a short chain alcohol ( $C_{1-6}$ ) is reacted with glucose or a polyglucoside ( $x=2$  to 4) to yield a short chain alkyl glucoside ( $x=1$  to 4) which can in turn be reacted with a longer chain alcohol ( $R_2OH$ ) to displace the short chain alcohol and obtain the desired alkyl polyglucoside. If this two step procedure is used, the short chain alkylglucoside content  
 20 of the final alkyl polyglucoside material should be less than 50%, preferably less than 10%, more preferably less than about 5%, most preferably 0% of the alkyl polyglucoside.

The amount of unreacted alcohol (the free fatty alcohol content) in the desired alkyl polysaccharide surfactant is preferably less than about 2%, more preferably less  
 25 than about 0.5% by weight of the total of the alkyl polysaccharide. For some uses it is desirable to have the alkyl monosaccharide content less than about 10%.

The used herein, "alkyl polysaccharide surfactant" is intended to represent both the preferred glucose and galactose derived surfactants and the less preferred alkyl polysaccharide surfactants. Throughout this specification, "alkyl polyglucoside" is used

to include alkyl polyglycosides because the stereochemistry of the saccharide moiety is changed during the preparation reaction.

An especially preferred APG glycoside surfactant is APG 625 glycoside manufactured by the Henkel Corporation of Ambler, PA. APG25 is a nonionic alkyl  
5 polyglycoside characterized by the formula:



wherein n=10 (2%); n=122 (65%); n=14 (21-28%); n=16 (4-8%) and n=18 (0.5%) and x (degree of polymerization) = 1.6. APG 625 has: a pH of 6 to 10 (10% of APG 625 in distilled water); a specific gravity at 25°C of 1.1 g/ml; a density at 25°C of 9.1 lbs/gallon;  
10 a calculated HLB of 12.1 and a Brookfield viscosity at 35C, 21 spindle, 5-10 RPM of 3,000 to 7,000 cps.

The instant light duty liquid nonmicroemulsion compositions can contain about 0.1 wt. % to about 12 wt. %, more preferably about 1 wt. % to about 8 wt. %, of at least one solubilizing agent selected from the group consisting of a C<sub>2-5</sub> mono, dihydroxy or  
15 polyhydroxy alkanols such as ethanol, isopropanol, glycerol ethylene glycol, diethylene glycol, propylene glycol, and hexylene glycol and mixtures thereof and alkali metal cumene or xylene sulfonates such as sodium cumene sulfonate and sodium xylene sulfonate. The solubilizing agents are included in order to control low temperature cloud clear properties.

20 The instant formulas explicitly exclude alkali metal silicates and alkali metal builders such as alkali metal polyphosphates, alkali metal carbonates, alkali metal phosphonates and alkali metal citrates because these materials, if used in the instant composition, would cause the composition to have a high pH as well as leaving residue on the surface being cleaned.

25 The final essential ingredient in the inventive compositions having improved interfacial tension properties is water. The proportion of water in the compositions generally is in the range of 10% to 95%.

The liquid cleaning composition of this invention may, if desired, also contain other components either to provide additional effect or to make the product more

attractive to the consumer. The following are mentioned by way of example: 0.3 wt. % to 3 wt. % of a perfume, colors or dyes in amounts up to 0.5% by weight; bactericides in amounts up to 1% by weight; in amounts up to 2% by weight; HEDTA for color improvement under stressed sun conditions, up to 1% and pH adjusting agents, such as sulfuric acid or sodium hydroxide, as needed. Furthermore, if opaque compositions are desired, up to 4% by weight of an opacifier may be added.

Preservatives which can be used in the instant compositions at a concentration of 0.005 wt. % to 3 wt. %, more preferably 0.01 wt. % to 2.5 wt. % are: benzalkonium chloride; benzethonium chloride, 5-bromo-5-nitro-1,3-dioxane; 2-bromo-2-nitropropane-1,3-diol; alkyl trimethyl ammonium bromide; N-(hydroxymethyl)-N-(1,3-dihydroxy methyl-2,5-dioxo-4-imidaxolidinyl)-N'-(hydroxy methyl) urea; 1-3-dimethylol-5,5-dimethyl hydantoin; formaldehyde; iodopropynyl butyl carbamate, butyl paraben; ethyl paraben; methyl paraben; propyl paraben, mixture of methyl isothiazolinone/methyl-chloroisothiazoline in a 1:3 wt. ratio; mixture of phenoxyethanol/butyl paraben/methyl paraben/propylparaben; 2-phenoxyethanol; tris-hydroxyethyl-hexahydrotriazine; methylisothiazolinone; 5-chloro-2-methyl-4-isothiazolin-3-one; 1,2-dibromo-2, 4-dicyanobutane; 1-(3-chloroalkyl)-3,5,7-triaza-azoniaadamantane chloride; and sodium benzoate. PH adjusting agents such as sulfuric acid or sodium hydroxide can be used as needed.

In final form, the instant compositions exhibit stability at reduced and increased temperatures. More specifically, such compositions remain clear and stable in the range of 0°C to 50°C, especially 5°C to 43°C. The liquid compositions are readily pourable and exhibit a viscosity in the range of 6 to 300 milliPascal . second (mPas.) as measured at 25°C. with a Brookfield RVTDV-II Viscometer using a #21 spindle rotating at 20 RPM. Preferably, the viscosity is maintained in the range of 10 to 200 mPas.

The following examples illustrate the liquid body cleaning compositions of the described invention. Unless otherwise specified, all percentages are by weight. The exemplified compositions are illustrative only and do not limit the scope of the

invention. Unless otherwise specified, the proportions in the examples and elsewhere in the specification are by weight.

### Example 1

Current LDL formulations use a sophisticated mix of several surfactants to achieve excellent grease cutting and foaming properties. Often even a small addition of an organic will cause the formula to become cloudy at either room temperature or when cooled, not to mention little beneficial impact on grease cutting properties. However, the incorporation of a small amount of a short chain (C8-C10) amine acts as co-surfactant and boosts the grease cutting efficacy as well as foam stability in the presence of soil. The following compositions in wt. % were prepared by simple mixing procedure:

	1	2
Mg linear alkyl benzene sulfonate	9	9
Na linear alkyl benzene sulfonate	3	3
AEOS 1.3 EO NH <sub>4</sub>	11.5	11.5
APG625	10	10
Lauryl myristal amido propyl amine oxide	5.4	5.4
C8/C10 amido propyl amine		1.0
Sodium xylene sulfonate	1.5	1.5
Pentasodium pentetate	0.125	0.125
Ethanol	6.2	6.2
Dimethylol dimethyl hydantoin	0.20	0.20
Perfume		
Water	Bal.	Bal.
pH	7.0	7.0
Appearance @RT	Clear	Clear
Appearance @4C	Clear	Clear
Cup tallow removal %	24.7	30.3
Inverted cylinder initial foam (ml)	377	372
Inverted cylinder foam with soil (ml)	165	195
Miniplates cleaned (#)	29	36